



An aerospace engineer tests avionics equipment.

Federal Government funding for research and development of new systems has also declined. Offsetting these declines, however, is the projected growth in the civilian sector due to orders from domestic and foreign airlines that need to accommodate increasing passenger traffic and to replace the present fleet of airliners with quieter and more fuel-efficient aircraft. Most job openings will result from the need to replace aerospace engineers who transfer to other occupations or leave the labor force.

Earnings

Median annual earnings of aerospace engineers were \$66,950 in 1998. The middle 50 percent earned between \$51,170 and \$82,620. The lowest 10 percent earned less than \$42,650 and the highest 10 percent earned more than \$93,880. Median annual earnings in the industries employing the largest numbers of aerospace engineers in 1997 were:

Aircraft and parts	\$72,200
Federal Government	70,000
Guided missiles, space vehicles, and parts	58,200

According to a 1999 salary survey by the National Association of Colleges and Employers, bachelor's degree candidates in aerospace engineering received starting offers averaging about \$40,700 a year; master's degree candidates, \$54,200; and Ph.D. candidates, \$64,400.

(See introduction to the section on engineers for information on working conditions, training requirements, and sources of additional information.)

Chemical Engineers

(O*NET 22114)

Nature of the Work

Chemical engineers apply the principles of chemistry and engineering to solve problems involving the production or use of chemicals. They design equipment and develop processes for large scale chemical manufacturing, plan and test methods of manufacturing the products and treating the by-products, and supervise production. Chemical engineers also work in a variety of manufacturing industries other than chemical manufacturing such as electronics, photographic equipment, and pulp and paper mills.

Because the knowledge and duties of chemical engineers cut across many fields, they apply principles of chemistry, physics, mathematics, and mechanical and electrical engineering. They frequently specialize in a particular operation such as oxidation or polymerization. Others specialize in a particular area such as pollution control or the production of specific products such as automotive plastics or chlorine bleach. Chemical engineers are increasingly using computer technology to optimize all phases of research and production; therefore they need to understand how to apply computer skills to process analysis, automated control systems, and statistical quality control.

Employment

Chemical engineers held about 48,000 jobs in 1998. Manufacturing industries employed over 70 percent of all employees, primarily in the



Although many chemical engineers are employed by manufacturers, much of the job growth is expected to occur in services industries.

electronics, petroleum refining, paper, chemical, and related industries. Most others worked for engineering services, research and testing services, or consulting firms that design chemical plants. Some also worked on a contract basis for government agencies or as independent consultants.

Job Outlook

Chemical engineering graduates may face keen competition for jobs as the number of openings is projected to be substantially lower than the number of graduates. Employment of chemical engineers is projected to grow as fast as the average for all occupations through 2008. Although overall employment in the chemical manufacturing industry is expected to decline, chemical companies will continue to research and develop new chemicals and more efficient processes to increase output of existing chemicals. Among manufacturing industries, specialty chemicals, plastics materials, pharmaceuticals, and electronics may provide the best opportunities. Much of the projected growth in employment of chemical engineers, however, will be in nonmanufacturing industries, especially services industries.

Earnings

Median annual earnings of chemical engineers were \$64,760 in 1998. The middle 50 percent earned between \$49,360 and \$81,520. The lowest 10 percent earned less than \$41,380 and the highest 10 percent earned more than \$92,240.

According to a 1999 salary survey by the National Association of Colleges and Employers, bachelor's degree candidates in chemical engineering received starting offers averaging about \$46,900 a year; master's degree candidates in chemical engineering, \$52,100; and Ph.D. candidates in chemical engineering, \$67,300.

(See introduction to the section on engineers for information on working conditions, training requirements, and sources of additional information.)

Civil Engineers

(O*NET 22121)

Nature of the Work

Civil engineers design and supervise the construction of roads, buildings, airports, tunnels, dams, bridges, and water supply and sewage systems. Major specialties within civil engineering are structural, water resources, environmental, construction, transportation, and geotechnical engineering.

Many civil engineers hold supervisory or administrative positions, from supervisor of a construction site to city engineer. Others may work in design, construction, research, and teaching.

Employment

Civil engineers held about 195,000 jobs in 1998. Almost half were employed by firms providing engineering consulting services, primarily developing designs for new construction projects. Another one third of the jobs were in Federal, State, and local government agencies. The construction industry, public utilities, transportation, and manufacturing industries accounted for most of the remaining employment. About 12,000 civil engineers were self-employed, many as consultants.

Civil engineers usually work near major industrial and commercial centers, often at construction sites. Some projects are situated in remote areas or in foreign countries. In some jobs, civil engineers move from place to place to work on different projects.

Job Outlook

Employment of civil engineers is expected to increase faster than the average for all occupations through 2008. Spurred by general



Civil engineers take safety and environmental concerns into account when designing construction projects.

population growth and an expanding economy, more civil engineers will be needed to design and construct higher capacity transportation, water supply, and pollution control systems; large buildings and building complexes; and to repair or replace existing roads, bridges, and other public structures. In addition to job growth, openings will result from the need to replace civil engineers who transfer to other occupations or leave the labor force.

Because construction and related industries—including those providing design services—employ many civil engineers, employment opportunities will vary by geographic area and may decrease during economic slowdowns, when construction is often curtailed.

Earnings

Median annual earnings of civil engineers were \$53,450 in 1998. The middle 50 percent earned between \$41,800 and \$74,550. The lowest 10 percent earned less than \$34,270 and the highest 10 percent earned more than \$87,350. Median annual earnings in the industries employing the largest numbers of civil engineers in 1997 were:

Federal government	\$64,000
Heavy construction, except highway	61,300
Local government, except education and hospitals	52,100
Engineering and architectural services	49,300
State government, except education and hospitals	48,900

According to a 1999 salary survey by the National Association of Colleges and Employers, bachelor's degree candidates in civil engineering received starting offers averaging about \$36,100 a year; master's degree candidates in civil engineering, \$42,300; and Ph.D. candidates in civil engineering, \$58,600.

(See introduction to the section on engineers for information on working conditions, training requirements, and sources of additional information.)

Electrical and Electronics Engineers

(O*NET 22126A and 22126B)

Nature of the Work

From computer chips that process millions of instructions every second to radar systems that detect weather patterns days in advance, electrical and electronics engineers are responsible for a wide range of technologies. Electrical and electronics engineers design, develop, test, and supervise the manufacture of electrical